Analysis $^{235}U/^{238}U$ Ratios in Paleo-Indian Artifacts by Thermal Ionization Mass Spectrometry (TIMS)*

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The Paleo-Indian occupation of North America, theoretically the point of entry of the first people in the Americas, is traditionally assumed to have occurred at about 12,000 yr B.P. This is inconsistent with older South American dates of around 32,000 yr B.P. and the similarity of the Paleo-Indian toolkit to Mousterian traditions that disappeared ~30,000 years ago.

We investigated a cluster of especially young dates for Paleo-Indian sites in the north-central area of North America that ranged from 160-3380 yr B.P. For example, at the Gainey site in Michigan a 2880 yr B.P. radiocarbon date was reported while the thermoluminescence date for that site is 12,400 yr B.P. Stratographic associations place Paleo-Indian occupations at depth in the prehistoric North American landscape, and cemented sediments on the artifacts show they were deposited before the formation of spodosols ended ~10,000 yr B.P.

Microscopic examination of chert artifacts revealed a high density of ~100μm diameter entrance wounds (~500/mm^2) and embedded particles, preferentially found on only one side of the artifact. A large concentration of micrometeorite-like material was found in the adjacent sediments. The nearly vertical direction of the tracks left by the particle impacts suggests they came from a distant source.

Various artifacts, cherts, sediments, and a control sample were sent to McMaster University Centre for Neutron Activation Analysis to determine ^{235}U and ^{238}U concentrations. All samples were found to have anomalous $^{235}U/^{238}U$ ratios as shown in Table 1. These results were controversial, requiring confirmation before they could be accepted. The original samples tested at McMaster could not be recovered for further analysis. Comparable samples were obtained and analyzed at the USGS in Menlo Park for their $^{235}U/^{238}U$ ratios with Thermal Ionization Mass Spectrometry (TIMS). This complimentary method typically yields higher precision than activation analysis. The TIMS measurements are compared with the McMaster results in Table 1. No anomalous $^{235}U/^{238}U$ ratios were observed, casting doubt on the previous data. It is unclear how the activation analysis could be in error, however it is plausible that secondary fast neutrons from ^{235}U fission in the targets may induce fissions in ^{238}U leading to excess delayed neutrons and a concentration dependent correction to the ^{235}U analysis.

Table 1: Comparison of Uranium Isotope Ratios

	USGS	McMaster[#]
Sample	$^{235}U/^{238}U$(%)	$^{235}U/^{238}U$(%)
Uraninite Standard	0.726±0.007	0.73±0.04
Bayport Chert	0.724±0.005	0.42±0.06
Gainey Chert	0.725±0.009	<0.4
Upper Mercer Chert	0.726±0.019	0.17±0.12
Chuska Chert	0.727±0.005	0.60±0.03
Fossil Hill Chert	0.732±0.00	- .

Evidence for a smaller terrestrial irradiation exists in ^{10}Be and ^{14}C data from tree rings and sediments suggesting cosmic ray producing events occurred from ≈42,000-16,000 years ago. A likely explanation is irradiation of the atmosphere by cosmic rays from nearby supernovas that were associated with formation of the local bubble. Excess radiocarbon produced in the atmosphere shortly after a nearby supernova would lead to anomalous radiocarbon dates.

Footnotes and References

* *Mammoth Trumpet,* March, 2002 (in press).

[#] *Mammoth Trumpet,* 16, 7 (2001).

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